Public Page
A New Approach to Control Running Fracture in Pipelines #141
Contract Number: DTRS56005-T-0003
Quarterly Report
March 1, 2006 – May 31, 2006
Battelle

Activities in the sixth quarter focused on formulating a stopgap fracture arrest model that could be used until a more general formulation is developed.

The stopgap fracture arrest model utilizes features of the original Battelle Two-Curve Model (BTCM), namely one curve that models the pressure versus velocity response of the gas as it decompresses due to the running fracture and a second curve that models the crack velocity in terms of the dynamic gas pressure.

The crack velocity - dynamic pressure curve is based upon the concept of an arrest pressure, below which the crack will not propagate. Originally, the arrest pressure was based on considerations of the flow stress, which depending on the formulation being used the flow stress is a function of the yield and/or ultimate stress of the pipe material, the Charpy impact toughness and an effective crack length. The effective crack length determined to best separate arrest from propagate data was $3(\text{Radius} \cdot \text{thickness})^{1/2}$. More recently the formulation used to compute the failure pressure, in this case the arrest pressure, for a particular crack size was improved and verified via full-scale bursts. This improved model, referred to as the Pipe Axial Defect Failure Criteria (PAFFC). Additional details of PAFFC can be found in: Eiber, R. J. and Leis, B. N., "FRACTURE CONTROL TECHNOLOGY FOR NATURAL GAS PIPELINES CIRCA 2001", PRCI Report No. PR-003-00108, July 2001.

During the past quarter the original BTCM as previously refined in this study was further enhanced by incorporating the PAFFC formulation for failure pressure into arrest pressure calculations. Doing so improves the accuracy of the arrest pressure estimate, particularly for higher grades of pipe steel. Including PAFFC in the current arrest length model provides a convenient stopgap to the fracture arrest model that is viable for rich gases until more general formulations can be develop.